DOCUMENT RESUME

ED 357 730 IR 015 988

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TITLE Using Integrated Media To Incorporate Research into Teacher Education.
SPONS AGENCY National Science Foundation, Washington, D.C.
PUB DATE 12 Nov 92
CONTRACT TPE-8751472; TPE-8950310; TPE-9053826
NOTE 13p.; Paper presented at the Annual Meeting of the Mid-South Educational Research Association (21st, Knoxville, TN, November 11-13, 1992).
PUB TYPE Guides - Classroom Use - Teaching Guides (For Teacher) (052) -- Reports - Descriptive (141) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Classroom Observation Techniques; Cooperation; Elementary Education; Elementary School Mathematics; *Fractions; Grade 2; Higher Education; Learning Readiness; Learning Theories; Lesson Plans; Masters Theses; Mathematics Instruction; *Preservice Teacher Education; Student Participation; Teaching Methods; *Theory Practice Relationship; Videotape Recordings; Visual Aids

ABSTRACT

This paper focuses on a lesson plan in fractional number concepts that illustrates how research and practice have been brought together through the use of integrated media. A teacher applied the findings from her master's thesis by collaborating with an instructor of elementary mathematics methods courses and an experienced teacher on a lesson plan that introduced the concept of "half" in a part-whole interpretation. A videotape was made of the lesson as it was presented to a second grade class with theory juxtaposed over the action through the use of a computer controlled videodisc environment. The videotape was used to guide the observations and analyses during a mathematics methods course for preservice teachers. The preservice teachers were assigned the task of comparing the research-based fractions lesson with another more traditional lesson taught by the same teacher using the topics of student involvement, readiness, or the role of representations in teaching fractions. Three appendixes contain: (1) an abstract of the master's thesis examining the issues of representation in the teaching and learning of fractional number concepts; (2) the lesson plan formed from the collaboration among the writer of the master's thesis, the instructor of the methods course, and the classroom teacher; and (3) the class assignment given to the preservice teachers comparing the research-based lesson with a traditional lesson on the same topic taught by the same teacher. (ALF)

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USING INTEGRATED MEDIA TO INCORPORATE RESEARCH INTO TEACHER EDUCATION

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Peabody College of Vanderbilt University

Presentation at the annual meeting of the Mid-South Educational Research Association, Knoxville, TN, November 12, 1992

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USING INTEGRATED MEDIA TO INCORPORATE RESEARCH INTO TEACHER EDUCATION

Implementing research into practice in teacher education is a primary goal at Peabody College. One vehicle which we have found promising for achieving that goal is integrated media. This paper focuses upon one particular lesson that illustrates how research and practice have been brought together through the use of integrated media.

Upon completion of her master's thesis that examined issues of representation in the teaching and learning of fractional number concepts, one of the authors applied her findings by collaborating with the instructor of the elementary mathematics methods course and another experienced teacher on a lesson plan that introduced the concept of half in a part-whole interpretation. (Appendix A is an abstract of the research addressed. Appendix B is the resulting lesson plan.) When the lesson was taught in a second-grade public school classroom, it was videotaped for use in the mathematics methods course for preservice elementary teachers. At this point, the lesson was available to the professor and the students for viewing at their convenience. However, videotape has shortcomings.

Because the lesson was grounded in research, it seemed useful to juxtapose the action and the underlying theory. Integrated media allow the merger of text and video through a computer-controlled videodisc environment. Thus, in many of our integrated media modules, the instructor and the preservice teachers have access to specific incidents in the lesson as well as to related questions, definitions, discussions, and bibliographic information. The text displayed on the computer screen in these modules guides the observations and analyses.

The goals of active student involvement and promotion of reflective teaching practices prompted the construction of a different type of software which would allow students to use integrated media to conduct their own primary investigations of the lesson in depth and to construct presentation modules that link video and discussion. The fractions lesson then became the object of analysis as students applied what they had learned through readings and other coursework in

order to create presentations that discussed such topics as student involvement, readiness, or the role of representations in teaching fractions.

Preservice teachers were given the class assignment in Appendix C which required them to compare the research-based fractions lesson with another, more traditional lesson taught by the same teacher. Neither of the lessons had previously been viewed or discussed in the course; thus, the methods students conducted their own evaluations of the events of each lesson. Through use of the software, students could isolate incidents in the lessons on videodisc and create accompanying text to be displayed on the computer screen, thus providing the means to present their ideas to their peers. Figure 1 shows a sample card produced by a group of students. The presentations prompted discussions that addressed complex issues of content and pedagogy. Student reaction to the assignment was quite favorable as they cited the power of video examples, the benefits of group discussions, and the depth of analysis.

In this illustration, the lesson was the conceptual vehicle for linking theory and practice. In a similar manner, the technology was the mechanical means for juxtaposing the two and for creating a learning environment in which the students could not only observe but also generate ideas.

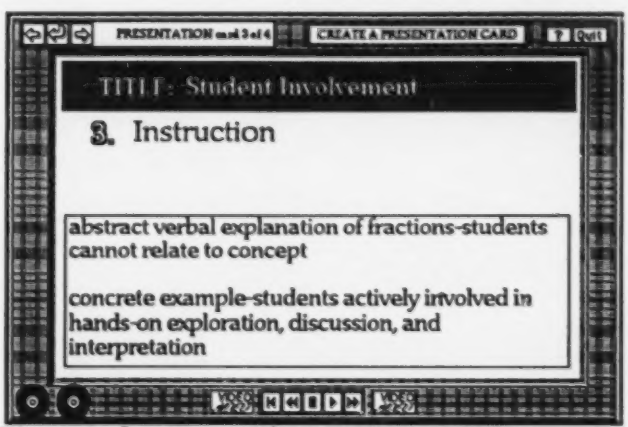

CREATE A PRESENTATION CARD
Quit
TITLE: Student Involvement
3. Instruction
abstract verbal explanation of fractions-students cannot relate to concept
concrete example-students actively involved in hands-on exploration, discussion, and interpretation

Figure 1. Sample card from student-created presentation stack.

APPENDIX A

Witherspoon, M. L. (1989). *The role of representations and interpretations in understanding of fractions*. Unpublished master's thesis, Vanderbilt University, Nashville, TN.

The purpose of the research was to investigate the nature of understanding of fractional numbers in the context of part-whole interpretations. The role of children's conception of the "unit" or the "whole," the role of representations, and the relationship of geometry and region models were particular focuses of the study. Working with a twelve-year-old student, "Nancy," who had exhibited a lack of understanding of fractions but not in other areas of mathematics, the researcher identified situations that exposed misconceptions. For example, Nancy demonstrated nonexhaustive distribution when she trimmed and discarded part of a 3x5 card she was partitioning into halves (Hunting & Sharpley, 1988; Piaget, Inhelder, & Szeminska, 1960). This misconception indicates that the student does not realize the relationship between the unit and its fractional parts. The fact that this relationship is stable across all units allows one to generalize about the idea of "half" apart from any physical representations and is thus vital to understanding part-whole fraction concepts.

Different representations—real-life, manipulative, pictorial, and spoken and written symbolic—posed varying levels of difficulty. Nancy found written symbols like "1/2" to be very troublesome. She was more successful with tasks that involved concrete or pictorial representations.

Geometric aspects of region models were sometimes obstacles to her understanding fractional number concepts. When shown a 3x5 card cut into halves along its diagonal, she identified only the triangle that was oriented with the right angle at the upper right corner to be half—the other piece looked "different" to her. Knowing that position is not one of the identifying characteristics of a triangle was necessary for her to see that the two triangles were both halves of the unit.

Teachers should be aware of misconceptions that students are likely to exhibit so that they can expose them and address them in instruction. Understanding the difficulties inherent in various representations of fractions allows teachers to choose and to sequence carefully the models that they use to build understanding. A rich environment that affords the opportunities to explore specific concepts from many different aspects is necessary for students to be able to construct meaning for such complex ideas as fractions.

References

Hunting, R. P., & Sharpley, C. F. (1988). Fraction knowledge in preschool children. *Journal for Research in Mathematics Education, 19*, 175-180.

Piaget, J., Inhelder, B., & Szeminska, A. (1960). *The child's concept of geometry* (E. A. Lunzer, Trans.). New York: Basic Books.

APPENDIX B

FRACTIONS LESSON: CONCEPT OF HALF

Objectives:

1. Use discussion and activities to teach the part-whole definition of half: half of a unit is one of two equivalent parts of the unit; the two parts put together form the original unit.

   Emphasize: 2 parts, same size or amount, nothing is wasted.

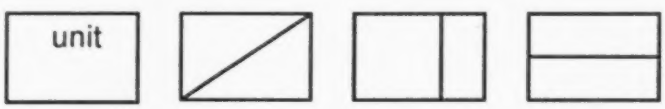
2. Explore students' understanding of half and build on what they know.

3. Expose students' misconceptions that relate to half and address those issues. [Anticipated misconception: nonexhaustive distribution--trimming uneven parts and discarding the extra. This modifies the original unit.]

4. Each student should be able to do the following:
   divide a stick of gum into halves;
   recognize halves when given the unit;
   write in their own words what they think <u>half</u> means.

Materials:

- 1 stick of sugarless gum for each pair of students and 1 for the opening discussion
- construction paper displays of a unit and various halves and pieces that are not halves



- for each student: 1 envelope with 3-3x5 cards--one will be marked with a dotted line for students to cut along and examine the parts to see whether they are halves.

Procedures and Discussion:

1. Real-life situation.

Two children will demonstrate how they would make halves of a piece of gum. [Emphasize that there should be two parts that are the same amount and that nothing should be wasted. If students divide the gum correctly the first time, question them about what they would do if the parts were not the same size.]

2. Introduce concept of **unit**.

"If I said, 'I'm going to give you half,' what would you ask me?" Emphasize that **half of what** is important. The **what** is the **unit**.

Display a rectangular region. Label it as the **unit.** Show various parts and have students tell whether they could be halves of the unit and why. When the class decides that parts could be

halves, write "half" on each part and display them reassembled into the unit. For the parts that are not half, put an "X" on each part and display them. [The markings will prepare students for the worksheet activity.]

3. Student activity.

Each student should open her/his envelope and mark one of the plain cards with the word **unit**.

- "This will be our unit for this activity. Find the card which has a line marked on it. If you cut along that line, do you think that the pieces would be halves?"

  Have each student cut along that line and decide whether he/she has halves. Let various students share with the class what they found and how they decided.

- Discuss with the class strategies for cutting the plain 3x5 card into halves. Demonstrate one of the suggestions, such as fold and cut. Have each student take the plain 3x5 card and cut it into two halves. Watch to be sure students do not trim and discard part of the original unit. Be sure they know that halves are two equivalent parts that use up all of the original unit.

4. Build the unit.

Have halves of various units (such as circles, triangles, etc.) cut out of felt. Hold up the halves and ask students to think about what the unit might look like if these are its halves. Let students come to the feltboard to put the halves together to form a unit. [Note that they may put the halves together to form a unit that looks different from the original one, but it is still a unit for those halves. For example, two halves which are congruent right triangles can be put together to form a unit that is a right triangle, a parallelogram, or a rectangle.]

5. Introduce the symbol "1/2."

When students give evidence of having a feeling for the concept of "half," introduce "1/2" as a short way for writing "1 half." Show "2/2" as a short way for writing "2 halves." Discuss with the students what the words and numerals have in common. Talk about why they think mathematicians would want to write the numerals instead of the words. **Students should be able to identify the symbol 1/2 with the words "one half."**

6. Worksheet.

Explain the directions for the worksheet. Refer to the previous activity. Tell the students that instead of writing the word, they will write "1/2" on the parts that are halves.

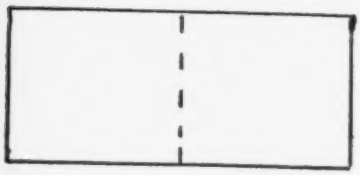
7. Closure.

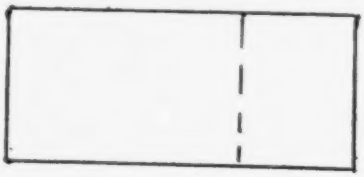
Have students share their answers to "What does 1/2 mean?" Give each pair of students a piece of gum to divide into halves and share.

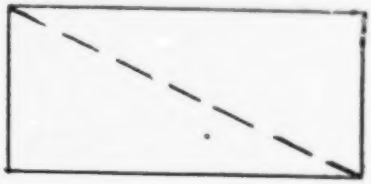
Name _____

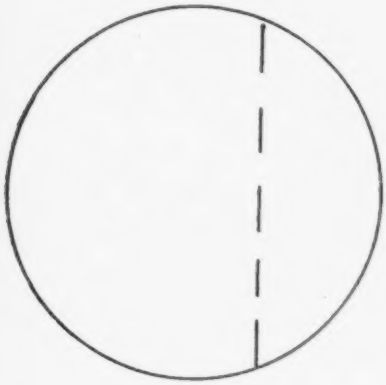
Date _____

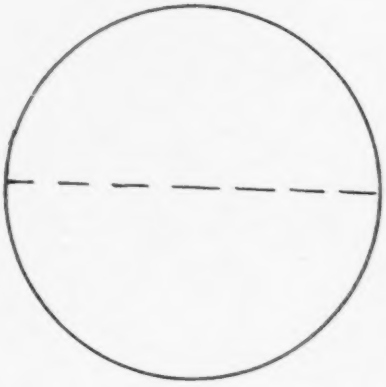
If the figure shows halves, write $\frac{1}{2}$ on each half. If the figure does not, put an X on each piece of the figure.

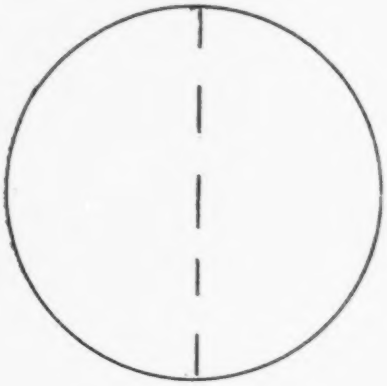


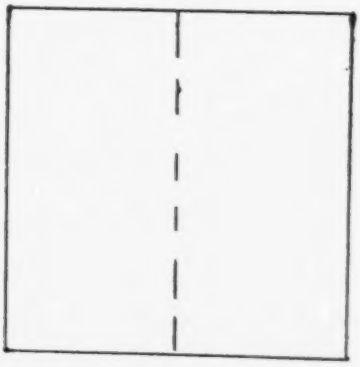


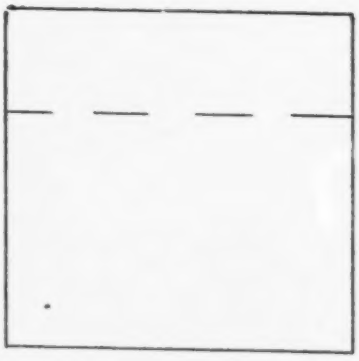












What does $\frac{1}{2}$ mean?

APPENDIX C

MTED 2060
Information on Assignment 2
Goal, Presentation Topics, and Evaluation
Group work on Wednesday, Feb. 5; group presentations on Monday, Feb. 10

Goal: Use focused observations of a pair of contrasting fractions lessons taught by an experienced teacher to gain knowledge and insights into planning, teaching, and evaluating your own lessons

Objectives:

Each group is to

1. describe to the class how one of the following aspects of teaching is addressed in two contrasting second-grade fraction lessons taught by an experienced teacher:

   representations,

   readiness,

   questioning,

   mathematical tasks posed in the lesson and student involvement in the lesson

   (These topics are discussed in more detail at the end of this handout.)

2. evaluate the effectiveness of each lesson with respect to these various considerations

3. use technology in the presentation

Group products:

1. presentation outline on transparency or computer diskette (including statement of main points about your chosen topic)

2. at least one video example to illustrate each main point in your presentation. (The video segments should be brief.) You will receive assistance with this. Other points may be summarized orally.

3. For the instructor, provide a brief summary of the group process used in preparing this assignment and of each individual's contribution to the group products. This should be prepared in hard copy form.

   Note: List all participant names on the group products, as appropriate.

Class time for presentation: approximately 10 minutes. You should time your presentation before class to be sure it is approximately this length of time.

Decisions:

1. the software to use in the presentation

   Option 1: Use new software developed through the Vanderbilt NSF projects that will allow you to type in your presentation outline and select video segments to illustrate your points. The result will be your own HyperCard stack, which will be used along with the videodisc for your presentation.

   Option 2: Prepare an overhead transparency for the outline and use a menu program for the video segments.

   Both options involve use of technology. Due to the availability of only one videodisc containing these lessons, one group will use option 1 and the remaining groups, option 2.

2. nature of presentation outline. Questions indicated in the topic description are a general guide to focus your observation of the lessons. You may want to emphasize some of the questions more than others. Your outline may include some of the questions from the handout along with your answers to the question or your comments or points you wish to make relative to the question.

3. the video examples to illustrate points in your presentation

4. each group member's responsibility--who presents what in the presentation, who discusses the video examples, who prepares transparency (if applicable), and who writes a short summary of the group process and what each group member did toward the presentation

Criteria for evaluation: (This assignment is worth 15 points.)

1. quality of presentation

   a) relevance of comments to chosen topic

   b) accuracy of comments

   c) appropriateness of selected video examples from the lesson

2. quality of written materials (outline and summary)

Presentation Topics

1. Role of representations in the lesson

As we discussed in class, researchers have identified different modes for representing mathematical ideas: real-life, concrete, pictorial, spoken symbols, and written symbols. Cite examples that indicate which representations the teacher used; the students used. Contrast the emphasis given to written symbols in the two lessons. Which lesson seemed more appropriate in this regard? Why?

For concepts to be meaningful, children must be able to use more than one representation and translate among the representations. Give an example in which students were required to understand more than one representation. What translations were made between or among these representations?

Evaluate the lessons in view of Bruner's teaching/learning sequence (concrete to pictorial to symbolic). Which lesson was more appropriate in this regard?

2. Readiness

What areas of readiness (content, pedagogical, maturational, affective, contextual) did the teacher address in each of these lessons? How was readiness provided in each of these areas?

Did the teacher assess the children's readiness in any of these areas? If so, identify which areas, and indicate how the assessment was conducted.

Were any necessary areas of readiness omitted?

How did the teacher of the "gum" lesson build on the children's prior experiences?

3. Questioning

Did the teacher use questions to stimulate students' thinking and understanding of concepts (for example, what "one-half" means)? Did the teacher use higher-level questions (e.g., application, analysis, synthesis, or evaluation)? Cite examples to illustrate different levels of questions used. In which lesson do you think questioning was used more effectively?

Did you note any questions that could be improved? If so, how might they be rephrased to be more appropriate?

What opportunities were given for students to ask questions (for example, did the teacher lead class discussions in a way that encouraged students to ask questions of the teacher and each other, or did the teacher introduce a problem solving activity which stimulated students to ask questions of each other as they collaborated to solve the problem)?

4. Mathematical tasks posed; student involvement

   a) Mathematical tasks are the problems, projects, constructions, or applications in which students engage during a lesson. They provide a focus for learning. Good mathematical tasks are ones that encourage discussion about mathematics, "that capture students' curiosity, and that invite them to speculate and to pursue their hunches" (NCTM, 1991, p. 25). What mathematical tasks did the teacher in each lesson pose for the students? In which lesson did the tasks seem more appropriate?

   b) In what ways were students involved in the two lessons? Indicate what you feel the learning outcomes of this involvement were.

Reference

National Council of Teachers of Mathematics, Commission on Standards for School Mathematics. (1991). *Professional standards for teaching mathematics*. Reston, VA: Author.

This work was supported by National Science Foundation Grants No. TPE-8751472, TPE-8950310, and TPE-9053826. Any opinions, findings, and conclusions expressed in this paper are those of the authors and do not necessarily reflect the views of the National Science Foundation.